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clude that the use of symbols of which the applicability is uncertain and the meaning too general is of little help in psychology.

Finally it may be mentioned that the interesting attempt to measure a time period by the ratio of a change occurring in it to a standard change also occurring in it fails, because this ratio is a number which becomes a time only when multiplied by a time unit. For such a standard we choose a certain amount of change in o , to which we refer as a standard, for instance the movement of a pendulum. One of the principal features of a standard is constancy, and measurement is impossible without it. We have therefore either a measurement which varies with time or our whole speculations about the specious present break down, because the differential quotient of a constant vanishes everywhere.

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REVIEWS AND ABSTRACTS OF LITERATURE

Some Peculiarities of Fluctuating and of Inaudible Sounds. KNIGHT DUNLAP. *Psychological Review*, Vol. XI., pp. 308-318.

The Effect of Stimuli upon the Traube-Hering Waves. C. E. GALLOWAY. *American Journal of Psychology*, Vol. XV., pp. 499-512.

The Effect of Closing the Eyes upon the Fluctuations of the Attention. BERTHA KILLEN. *American Journal of Psychology*, Vol. XV., pp. 512-514.

The last two of these articles can not well be discussed apart from a series of experiments that have been carried on under the general supervision of the reviewer, and it may therefore be well to take advantage of this opportunity to summarize the earlier results and the general theory which lead to the experiments and which they confirm and support.

This theory, first proposed by Dr. Slaughter in 1901, is, in outline, that the attention waves are related with two physiological rhythms, the rhythm of respiration and the rhythm of blood pressure or change in arterial volume variously known as the Traube-Hering or Sigmund Mayer waves. The evidence was direct. The stimulus appeared during the expansion of the blood-vessels and disappeared during their contraction. The correlation was confirmed by Bonser in ignorance of Dr. Slaughter's results, with the difference that he asserts that disappearance corresponds to expansion, appearance to contraction in volume. Study of his curves, however, indicates that usually the coincidence is not so direct, that the contraction usually begins during the period of appearance, and lasts well over into the time of disappearance. Further evidence is needed on this point, but it seems probable that the results are not so divergent as the verbal formulations would indicate.

Two facts have developed with reference to the influence of stimulations upon the attention waves. These were first formulated by Taylor. The length of the attention wave is affected, usually lengthened, and the ratio between the times of appearance and disappearance is altered. The first suggested at once the similar phenomena in pulse and respiration, and seemed at first sight to support Slaughter's theory. Mr. Galloway's experiments sought to determine whether stimuli did actually have an influence upon the length of the Traube-Hering waves. His results were that the stimuli used, both pleasant and unpleasant, strong and weak, had the effect of lengthening the waves in every instance for the individuals experimented upon. This is confirmatory of the theory so far as it goes, but it is still necessary to study the influence of the stimuli upon the attention and vaso-motor waves simultaneously.

Another bit of evidence of the same tenor is offered by Mr. Galloway's work in the fact that attention and vaso-motor waves have the same daily rhythm of changes in length. In addition it was found that the average length of the two waves was very nearly identical for three subjects, in spite of the fact that they were taken several months apart; for a fourth, the attention waves were approximately double the vaso-motor; and the fifth observer was of the respiratory type—his attention waves corresponded to the respiratory rhythm.

If we bring together the evidence so far accumulated as to the relation of attention and vaso-motor waves we find that they occur simultaneously, that both are influenced by stimuli and usually in the same direction, and that the lengths of the two waves are approximately identical for a given individual at the corresponding time of day.

The second influence of stimuli is touched upon in Miss Killen's paper. Mr. Taylor found that any stimulus tends to increase or decrease the ratio of appearance to disappearance. The result was confirmed in part by Heymans, in that electrical stimulation inhibited weak tones, and in a measure by the work of Wiersma and the reviewer on the attention wave in fatigue in so far as we may regard the ratio between periods of visibility and invisibility as an indication of the functional capacity of cortical cells.

Miss Killen reinvestigated a result, first obtained by Münsterberg and recently cited by Pace as an obstacle to a central explanation of the fluctuations—that closing the eyes at intervals during attention to minimal stimuli would make continuous what previously had been an intermittent sensation. Her investigations indicate that the result obtained by Münsterberg is not universal, but holds only for one type of individual under special conditions. What does happen is that the time of visibility is lengthened or diminished according to personal peculiarity—in one person it was increased, in another diminished and in a third was diminished during one part of the experiment and increased during another. Whether it is increased or diminished depends upon whether the stimulus from closing the eyes exercises reinforcing or inhibiting influence upon the cortical cells involved. The only case in which the fluctuations would disappear would be when the stimulus was near the limen

of fluctuation, and the observer one for whom closing the eyes was a reinforcement. This condition was obtained but once in the entire set of experiments. Miss Killen concludes, then, that the Münsterberg phenomenon can be more easily explained from the central than from the peripheral theory.

Two facts that must have an important bearing upon any theory of attention waves result from the investigation of Dr. Dunlap.

1. Interruption of a minimal sound during the period of disappearance was in more than half the cases correctly noticed by the observer. The sounds were given by tuning-fork and telephone, and could be easily interrupted by the experimenter. The experiments were extended to show that sounds which were inaudible when continuous could be heard at their beginning or cessation. It is noteworthy that the cessation attracted attention more often than the beginning. The author does not attempt any theory, but lets the facts stand for what they are worth. To the reviewer, however, they seem to make strongly for a central theory. Certainly if the peripheral connections were entirely broken there could be no consciousness of the interruption. The fact also suggests an explanation of Pace's observation that when a weak visual stimulus was interrupted during the period of invisibility an after-image could still be seen.

2. In direct contradiction to both Dr. Heinrich and Professor Titchener it was found that minimal pure tones fluctuated. Both tuning-forks and the singing flame were used as sources of sound, and each of five observers clearly noticed the fluctuations.

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Die Farbenempfindung der Netzhautperipherie bei Dunkeladaptation und konstanter subjectiver Helligkeit. WILHELM PETERS. *Archiv für die Gesamte Psychologie*, III., 4, 1904, S. 354-387.

This investigation is concerned with a determination of the relative sensitivity of the different regions of the retina to brightness and to saturation. Peters worked in the dark-room of the psychological laboratory at Leipzig, with a modified form of the Hellpach perimeter. His four stimuli—red, yellow, green and blue—were, like Hellpach's, built up by means of light transmitted through appropriate color filters.

The most prominent feature of Peters's results is their extreme irregularity. The author feels justified, however, in interpreting them to mean that the retinal surface is to be regarded as a tripartite structure, containing a semiperipheral zone upon which color-stimuli appear in lesser saturation than upon more central and more peripheral regions. This interposed zone of minimal saturation is said (*S.* 380) to extend in the great majority of cases, from 35° to 55°, but his tables (*S.* 370f.; 374-8) indicate that its position and extension are wholly fortuitous. Thus it may extend from 15° to 45°, from 15° to 55°, from 15° to 25°, from 25° to 35°, from 25° to 75°, or from 45° to 65°. On one half-meridian it occurred twice, at 15° and again at 65°; while in numerous instances it